Update/Le point

Physical exercise in the management of hypertension*

World Hypertension League[1]

The World Hypertension League is an association of antihypertensive leagues, hypertension societies, committees and other national bodies whose aim is to control hypertension in populations. The present paper is the third in a series of statements on topics that are of practical importance for the management of hypertension, and are addressed to practising physicians. Like the earlier papers, it has been repeatedly and extensively discussed by representatives of the league's member organizations and accepted as a consensus document.

Physical activity is widely regarded as a protective factor against cardiovascular diseases. Conversely, physical inactivity is considered to be a cardiovascular risk factor.

The relation between physical activity and blood pressure has been determined from epidemiological data and from various controlled studies in which normotensive and hypertensive subjects underwent physical training.

Physical activity, physical fitness, and blood pressure

Epidemiological studies

Various studies have analysed the relation between blood pressure and physical activity using data obtained from questionnaries and interviews with people at work or leisure or both. Other studies have used an exercise test to assess physical fitness or performance capacity; however, this is determined not only by physical activity and training but also by genetic factors (*1*). The assessment of physical activity from responses to questionnaires and interviews bears only a poor relationship to measured physical fitness: some physically active people may appear unfit on testing and some physically inactive may appear fit. In general, the methods used to assess physical activity lack accuracy and differ widely between studies.

Several confounding variables may affect the relation between physical activity, physical fitness, and blood pressure. Some of these, such as age, weight, and obesity, can be accounted for in analyses; others, such as self-selection and genetic effects, cannot easily be controlled. Several large studies, involving more than 13 500 subjects, and

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[1] Prepared by R. Fagard, Leuven, Belgium, whose work is gratefully acknowledged. The text has been accepted by the member organizations of the World Hypertension League, which in March 1990 comprised the following: National Heart Foundation of Australia; Belgium Hypertension Committee; British Hypertension Society; Canadian Coalition for High Blood Pressure Prevention and Control; Chinese Hypertension Society; Danish Society of Hypertension; French National Committee against Arterial Hypertension; German League against Hypertension; Hellenic Society of Hypertension; Hypertension Society of the Hungarian Society of Cardiology; All India Heart Foundation; Israel Hypertension Society; Italian League against Hypertension; Japan Heart Foundation; Hypertension League of Morocco; Netherlands Heart Foundation—Hypertension Committee; Norwegian Society of Hypertension; Polish Society of Hypertension; Portuguese League against Hypertension; Senegal Foundation for Hypertension and Heart Disease Control; Southern African Hypertension Society; Spanish League against Hypertension; Swiss Association against High Blood Pressure; Uruguayan Hypertension League; U.S. National High Blood Pressure Education Program; Zaire League against Arterial Hypertension; and International Green Cross. Requests for reprints should be sent to World Hypertension League, 20 avenue du Bouchet, 1209 Geneva, Switzerland.

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which allowed for age and anthropometric characteristics, have reported an inverse relation between blood pressure and either habitual physical activity (*2–4*) or measured physical fitness (*5, 6*). Also, in a follow-up study of college alumni, Paffenberger et al. observed that vigorous exercise was inversely related to the later development of hypertension, especially in the obese (*7*).

Not all epidemiological studies support this view (*8*); however, the low level of physical activity in Western societies may have hampered the detection of such a relation. Moreover, in studies that did find a significant association, the difference in blood pressure between the most and the least physically active subjects amounted to not more than 5 mmHg (*5, 6*). Such a small reduction may have important consequences for the morbidity and mortality of populations, but is of no practical benefit to the individual.

Training studies

The effect of physical training on blood pressure has been assessed in many studies (*9*). Only controlled studies are considered in this article, i.e., studies in which parallel nontraining control groups were followed or which included a nontraining phase. It should be realized, however, that patients cannot be blinded to the treatment in training studies. Most studies used so-called "endurance" training (prolonged dynamic, predominantly isotonic, exercise of large muscle groups), for example, walking, running, cycling, swimming, and cross-country skiing. In this context, endurance does not imply extreme exertion, such as that experienced in a marathon race.

Studies of the effect of "static" or isometric training, which involves muscle contractions with limited or no movement of the subject, and is thus performed at relatively constant muscle length, have also been carried out; examples are weight-lifting and wrestling.

Endurance training. Data on the effect of endurance training on blood pressure have been reported for at least 29 study groups of normotensive and hypertensive subjects, mostly men, of average age range 16–70 years. The duration of the training was 1–8 months, carried out mostly in three weekly sessions of 30–120 minutes each. The intensity of the training varied from 50% to 90% of maximal exercise capacity. The training programmes produced increases in exercise capacity of 6% to 38%, and the subject's weight usually remained unchanged.

In normotensive individuals the change of systolic/diastolic blood pressure in response to training, after adjustment for control observations, averaged −4/−4 mmHg. Adjustment for control observations took into account blood pressure changes in the parallel control group or changes during the nontraining phase in cross-over studies. The abovementioned change is similar in magnitude to the difference in blood pressure between physically active and inactive populations. In hypertensive patients, training produced an average change of −11/−6 mmHg. Fig. 1 illustrates the training-induced change in systolic blood pressure and the change in physical work capacity reported in each study. A greater blood-pressure response can be expected for individuals with the greatest increase in work capacity, but the association is weak. This relationship was also less clear when the effects of several levels of exercise were studied in the same subjects (*10, 11*). No significant relationship was observed for changes in diastolic blood pressure. Further analysis of these studies suggests that age is not a significant determinant of the blood-pressure response to training.

The effect of training on blood pressure measured during exercise has also been assessed (Fig. 2). In normotensives the results are not consistent, with decreases of 0–12 mmHg in systolic blood pressure at a fixed submaximal work-load (*12–15*). In hypertensives, changes of −20 mm Hg and −25 mm Hg have been observed (*16, 17*). Some benefit could accrue from having a lower blood pressure during submaximal exercise, since the majority of individuals spend most of their time in a non-basal state. One study that monitored blood pressure for 24 hours showed that physical training

Fig. 1. **Changes in systolic blood pressure (mmHg) following exercise training, adjusted for control data, versus changes in physical work capacity (%).** Each point represents the average for one group of subjects (for review, see ref. *9*).

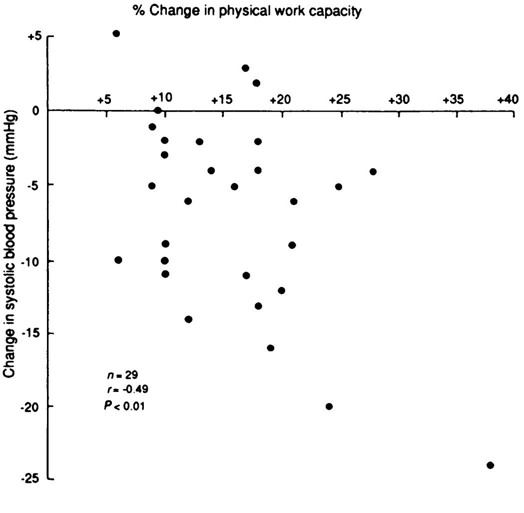
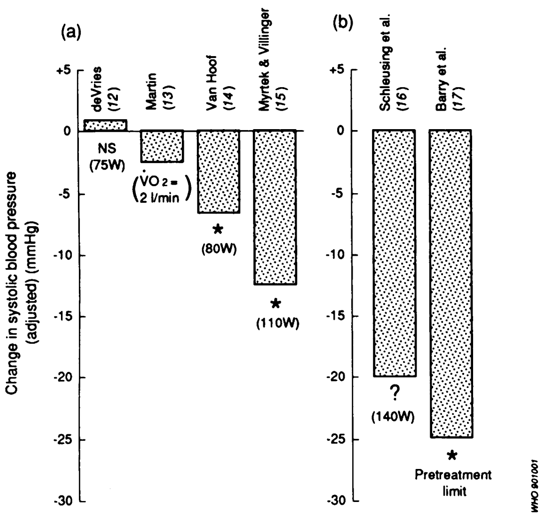


Fig. 2. **Changes in exercise systolic blood pressure (mmHg), following training, adjusted for control data, in (a) normotensive and (b) hypertensive subjects.** Data are reported at a fixed work-load $\dot{V}O_2$, watt (W) or pretraining work-load limit. NS = not significant; * = $P < 0.05$; ? = significance not given.



lowered the blood pressure during the day but not during the night (*14*).

Although the hypotensive effect of endurance training seems to be established, the haemodynamic mechanism remains controversial since it is not clear whether the decrease in blood pressure is due to reduced cardiac output (*18*) or reduced systemic vascular resistance (*10, 11*). Reduced sympathetic activity is most probably involved (*10, 11, 18*), and an increase in the cross-sectional area of resistance vessels following opening and proliferation of the capillary bed in trained muscles could be responsible (*19*).

Isometric training. Isometric exercise produces an acute increase in blood pressure (*20*). However, most studies indicate that strength-training does not lead to persistent changes in blood pressure; some have reported slight reductions. Nevertheless, any hypotensive effect appears to be considerably lower than the effect that can be achieved with dynamic, predominantly isotonic, exercise training (*9*). There is no evidence that strength-training is associated with increased morbidity or mortality.

Other effects of physical activity

Physical activity is an important adjunct to the treatment of obesity and has a favourable effect on insulin sensitivity, diabetes control, and plasma lipid levels (*21*). Physically active individuals live longer (*22, 23*) and the favourable association persists after adjustment for confounding factors. A recent meta-analysis of the combined results of ten randomized clinical trials of patients after myocardial infarction has suggested that comprehensive cardiac rehabilitation, including exercise and risk factor reduction, reduces total and cardiovascular mortality by 25% (*24*); the results were similar for those studies in which rehabilitation included exercise with some risk factor management and for those that emphasized risk factor management plus exercise or exercise advice.

In 80% of cases, exercise-related sudden death in middle-aged men is due to ischaemic heart disease. In approximately one third of such cases where blood pressure records could be traced, hypertension was found, which could suggest that patients with hypertension run a higher risk of sudden death during exercise. Exercise-related sudden death is rare in women (*9*).

Recommendations

Physical training can be advocated together with other non-pharmacological measures in cases of mild hypertension, or as an adjunct to pharmacological treatment in more severe cases of hypertension. Whether the effect on blood pressure control of these various measures is merely additive or synergistic is not known. It is proposed that the usual guidelines for initiating drug therapy be followed (*25*). Detailed exercise prescription and regular encouragement and follow-up are necessary to improve compliance.

Characteristics of the recommended exercise

Type of exercise. From the results reported in the literature, endurance training is the preferred type of exercise. This includes walking, running, cycling, swimming, cross-country skiing, and callisthenics.

Frequency, duration and intensity of exercise. Epidemiological studies indicate that individuals who have a more physically active life-style have lower blood pressure than the less physically active (*2–8*). The effect on blood pressure of introducing an active life-style has never been investigated. Intervention studies have used structured training programmes, which in addition to the type of exercise, are characterized by duration, frequency, time per session, and intensity of exercise. A favourable effect on capacity for physical work and probably on blood pressure can be achieved by various combinations of these training characteristics. Low-intensity exercise requires more time than high-intensity training. Three weekly sessions of 45 minutes at 60–70% of maximum work capacity for one month (*11*) and three weekly sessions of 60 minutes at 47% intensity for 2.5 months (*26*) have produced similar results. Exercise can therefore be tailored to the individual patient. For some, moderate cycling or brisk walking for 30–60 minutes three to five times a week will be suitable, whereas others will be able to take up more intensive cycling or jogging for 20–30 minutes three times a week.

The advice to patients should be given in terms which they can easily understand:

1) *Type, frequency and duration.* Examples:

- brisk walking five times a week for 30 minutes;
- jogging three times a week for 20 minutes.

2) *Intensity.* Intensity can be expressed by the level of perceived exertion; for example: "You should be able to talk during your exercise; if you cannot, you should decrease the exercise".

Training intensity can also be based on heart rate. The heart rate (HR) at which the subject is advised to train can be calculated from the formula:

$$\text{Exercise HR} = \text{resting HR} + (X\% \text{ of } (\text{maximal HR} - \text{resting HR}))$$

where $X < 50\%$ is considered light exercise; $X = 50–70\%$, moderate exercise; and $X > 75\%$, heavy exercise.

Maximal heart rate can be determined accurately by an exercise test. It can also be calculated using the equation: maximal $\text{HR} = 220 - \text{age}$ in years, but this formula is not very accurate; the variance of peak heart rate is accounted for by age is about 40%. Furthermore, exercise heart rate is affected by antihypertensive drugs, particularly beta-blockers. If, based on this formula, the initial training intensity appears to be inappropriate, it can be adjusted individually.

In general, it is prudent to start with light-to-moderate exercise and to increase the intensity progressively, adapted to the individual subject.

Implementation

Most patients with hypertension are middle-aged or elderly and have not been exercising regularly. Regular physical activity will therefore involve a change in life-style and require regular encouragement and follow-up. Group programmes are likely to improve adherence.

Assessment of the hypertension patient before training

Hypertension is a risk factor for cardiovascular morbidity and mortality. A resting electrocardiogram should be included in the work-up of a hypertensive patient. In addition, before starting an exercise programme, an exercise test may be recommended for previously sedentary patients, particularly when other risk factors such as smoking, obesity, or hyperlipidaemia are present, or when the patient complains of dyspnoea or chest pain. Knowledge of the patient's exercise capacity and heart-rate response to exercise will assist in advising on exercise intensity.

When left ventricular hypertrophy is present, a cautious approach should be advocated and a low-intensity exercise protocol recommended. In the presence of ischaemic heart disease, it is advisable to start exercise with a supervised programme.

Drug treatment of the exercising hypertension patient

Care is needed in the choice of antihypertensive drugs for the exercising patient (*9*). Beta-blockers can have an unfavourable effect on sustained submaximal exercise; the duration of exercise at 50–60% of maximal oxygen uptake is reduced by 40–50% with non-selective beta-blockers and by about 20% with selective beta-blockers. The impairment of peak oxygen uptake averages about 7%. Diuretics, particularly during short-term treatment, reduce exercise capacity, probably by reducing plasma volume; there are no data on the effects on exercise capacity of long-term diuretic treatment. Drugs that reduce systemic vascular resistance (such as calcium channel blockers, converting enzyme inhibitors, and alpha-blockers) have no effect on exercise capacity, but alpha-blocking drugs may produce symptomatic post-exercise hypotension. Beta-blockers, but not calcium antagonists, may impair the cardiovascular response to physical training.

Conclusion

Exercise programmes can contribute to the management of hypertension and enhance the sense of well-being, and they may improve life-expectancy. They need not be arduous and can be designed to fit into patient's everyday activities.

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